Prior-Guided Image Reconstruction for Accelerated Multi-Contrast MRI via Generative Adversarial Networks

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Abstract

Multi-contrast MRI acquisitions of an anatomy enrich the magnitude of information available for diagnosis. Yet, excessive scan times associated with additional contrasts may be a limiting factor. Two mainstream frameworks for enhanced scan efficiency are reconstruction of undersampled acquisitions and synthesis of missing acquisitions. Recently, deep learning methods have enabled significant performance improvements in both frameworks. Yet, reconstruction performance decreases towards higher acceleration factors with diminished sampling density at high-spatial-frequencies, whereas synthesis can manifest artefactual sensitivity or insensitivity to image features due to the absence of data samples from the target contrast. In this article, we propose a new approach for synergistic recovery of undersampled multi-contrast acquisitions based on conditional generative adversarial networks. The proposed method mitigates the limitations of pure learning-based reconstruction or synthesis by utilizing three priors: shared high-frequency prior available in the source contrast to preserve high-spatial-frequency details, low-frequency prior available in the undersampled target contrast to prevent feature leakage/loss, and perceptual prior to improve recovery of high-level features. Demonstrations on brain MRI datasets from healthy subjects and patients indicate the superior performance of the proposed method compared to pure reconstruction and synthesis methods. The proposed method can help improve the quality and scan efficiency of multi-contrast MRI exams.